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Magnetic field effect on the TGS:Cr dielectric properties and real structure

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We present the effect of a constant magnetic field on the dielectric properties of a ferroelectric, its domain structure, and distribution of defects in it. The nominally pure triglycine sulfate single crystal with specially introduced chromium impurity (TGS:Cr) was studied. The samples were kept in a constant magnetic field $B = 2T$ for 20 minutes, and the magnetic induction vector **B** was perpendicular to the axis **Y** of spontaneous polarization. To study the anisotropy of the effect, two orientations of the samples in a magnetic field were examined – **B**||**X** and **B**||**Z**. The dielectric properties were controlled by measuring the dielectric hysteresis loops *P-E* and the temperature dependence of the dielectric constant $\varepsilon'(T)$ near the phase transition. The domain structure and topography of the polar (010) cleavage were studied by the methods of the atomic force microscopy (AFM).

The significant changes in the properties of the samples after magnetic exposure were found. Figure 1 shows the dependences of the relative change in the maximum of the dielectric constant in the heating and cooling modes. It is seen that the magnetic field influence is a long-term post-effect. About a day after the magnetic exposure, an increase in the dielectric constant near the phase transition by 27% was observed, and a return to the initial value took place after 10 days.

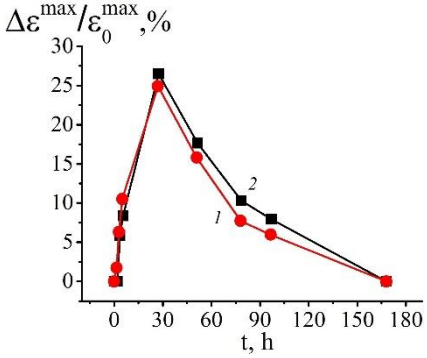

Figure 1. The dependences of the relative change in the maximum of dielectric constant of TGS: Cr crystal on the time after exposure to a constant magnetic field in the heating (1) and cooling (2) modes.

Similar time changes were observed in the defect structure of crystal. According to [1], the criterion for a defect state of TGS is the density and distribution of the nanorelief elements (rounded islands and pits of submicron lateral sizes on the polar (010) cleavage). The exposure of TGS: Cr in a constant magnetic field led to a significant change in the distribution of the nanorelief elements. The maximum decrease in the average size of nanorelief elements was observed approximately a day after the magnetic effect, as in the case of the dielectric properties change.

The comparison of the results obtained by various methods allows to suggest that the observed changes are associated with magnetostimulated transformation of defects, which are the centers of pinning of the domain walls. The changes in the defect subsystem of crystals under the action of magnetic field have been studied in detail when investigating the magnetoplastic effect in nonmagnetic crystals (see, for example, review [2]).

1. N. V. Belugina et al., *Crystallogr*. **56**, 1070 (2011).
2. V.I. Alshits et al., *Dislocations in Solids* **14**, 333 (2008).